BULLETIN

OF THE

ESSEX INSTITUTE.

VOL. 3. SALEM, MASS., DECEMBER, 1871. NO. 12.

One Dollar a Year in Advance. 10 Cents a Single Copy.

REGULAR MEETING, MONDAY, DECEMBER 4, 1871.

President in the chair.

Records of preceding meeting read.

The Secretary read the following extract of a letter from Col. J. W. Foster, President of the Chicago Academy of Sciences.

November 15, 1871.

Our Academy meeting on Tuesday was well attended, and an earnest feeling was expressed by all to work more faithfully in the days of our adversity than in those of our prosperity. Mr. Walker on behalf of the Trustees made an informal statement as to our pecuniary condition. We have about $60.000 to enable us to rebuild. He expressed a strong hope that the Academy would be able to secure a donation of an entire block near the lake shore whereon to erect a new building, and that before the expiration of two years, though he did not speak positively, the members might reassemble under their own roof. The action of the Essex Institute was prompt and generous, and was gratefully appreciated by us all.

Very truly, J. W. Foster.

The Secretary also announced the following correspondence :—

From Joshua Coit, Salem, Nov. 25; D. Dorchester, Salem, Dec. 1; J. C. Holmes, Detroit, Mich., Nov. 28; S. C. Jackson, Boston, Nov. 23, 25, Dec. 1; William Stimpson, Ilchester, Howard Co., Md., Nov. 13.

The LIBRARIAN reported the following additions:—

By Donation.

AUSTIN, COL. F. Characters of some new Hepatiæ, 8vo pamph.

BOLLES, E. C. Catalogue of Officers and Students of Trinity College for 1871-72. Miscellaneous pamphlets, 9.

CLOGSTON, WM., of Springfield, Mass. Rochester Directories for 1857, '59, 1863-4, 1864-5, 1866-67, 1867-68. 6 vols. 8vo. Wheeling Directory, 1868-9. 1 vol. 8vo. Directory of South Norwalk for 1871. 1 vol. 8vo. Oswego and Fulton Directory, 1862-3. 1 vol. 8vo. Oswego County Directory, 1869-70. 1 vol. 8vo. Zanesville Directory. 1860, 1 vol. 8vo. Northern New York Business Directory, 1867-8. 1 vol. 8vo. Xenia City and Greene Co. Directory, 1870-1. 1 vol. 8vo. Ohio State Register, 1857. 1 vol. 8vo. Springfield, Ohio, Directory, 1868-9, 1 vol. 8vo. Columbus Directory, 1870-1. 1 vol. 8vo. Oneida County Directory, 1862-3. 1 vol. 12mo. Auburn Directory, 1863-4. 1 vol. 8vo. Utica City Directory, 1865-66. 1 vol. 12mo. Genesee Directory, 1869-70. 1 vol. 8vo. Chillicothe Directory, 1869-70. 1 vol. 8vo. Schenectady Directory, 1868-9. 1 vol. 8vo. Buffalo City Directory, 1869. 1 vol. 8vo. Columbus Directory, 1843-4. 1 vol. 12mo. Manchester Directories, 1846, 1848, 1852, 1856. 4 vols. 16mo. Nashua Directory, 1857-8. 1 vol. 16mo. Massachusetts State Directory, 1850-1. 1 vol. 16mo. Treble Almanac of Dublin, 1829. 1 vol. 12mo. Directory of Akron, Alliance, Cuyahoga Falls, Middlebury, etc., 1870-1, 1 vol. 8vo. Sermon preached in West Springfield, Mass., June 25, 1871, by Rev. S. E. Vermilye, D. D. 8vo pamph.

GREEN, S. A., of Boston. Catalogue of Monson Academy. 1871-2. 8vo pamph. Miscellaneous pamphlets, 13.

LEE, JOHN C. Commercial Bulletin for Nov. 1871.

NEAL, THEODORE A., of Boston. Boston Board of Trade, 1856, 1857, 1859, 1860, 1862, 1863, 1864. 7 vols. 8vo. Land Office Report for 1867. 1 vol. 8vo. Commercial Agency Register, 1868. 1 vol. 4to. Rules and Orders of the Senate. 1 vol. 8vo. Guide Books, 4. Almanacs, 3. Miscellaneous pamphlets, 27.

SMITH, CHARLES C. Services in memory of Rev. E. S. Gannett, D. D., Aug. 30, 1871. 8vo pamph.

WALLIS, MRS. JAMES A. Manuscript Journals kept by the late Asa Lamson, 11 vols. Interleaved Almanacs, 12.

By Exchange.

YALE COLLEGE LIBRARY. Catalogue of the Officers and Students in Yale College for 1871-72. 8vo pamph.

PUBLISHERS. Christian World. Gloucester Telegraph. Haverhill Gazette. Land and Water. Lawrence American. Little Giant. Lynn Reporter. Lynn Transcript. Medical and Surgical Reporter. Nation. Nature. Peabody Press. Sailor's Magazine and Seaman's Friend. Shoe and Leather Journal. Silliman's Journal. Sotheran's Catalogue.

The following donations to the Historical Department were announced:—

KIMBALL, WILLIAM. View of Essex street from opposite the Market House to Washington street, painted by Joseph Cloutman about 1834.

SHEPARD, M. W. Two portraits in crayon of David Ropes and his wife of Salem. David Ropes, son of Benjamin and Hannah (Moses) Ropes, bapt. Apr. 14, 1739; variously styled "cooper," "trader," "gentleman," "innkeeper" and "merchant;" married, Oct. 9, 1760, Priscilla, dau. of Jonathan and Elizabeth (Sanders)

Webb; died Dec. 20, 1793. The widow long survived him, preserving in her last years a force of character and amiability which made her the object of constant and grateful attentions from a large circle of relations. She died Oct. 5, 1831, aged 91 years. (See Hist. Coll. of Essex Institute, vol. III, p. 125, and vol. VII, p. 162.)

Rev. E. S. Atwood occupied the hour of the meeting with an interesting and instructive communication on the "Beginnings and Growth of Language." It contained much curious and entertaining information and many valuable thoughts, and was listened to with great pleasure by a large audience.

Regular Meeting, Monday, December 18, 1871.

The President in the chair.

Records of preceding meeting read.

The Secretary read the following letter from the Secretary of the Chicago Academy of Sciences :—

Ilchester, Howard Co., Md., Dec. 4, 1871.

Dear Sir — The Chicago Academy of Sciences will hold a meeting on the 12th inst., at which time the Resolutions of the Essex Institute, communicated in your esteemed favor of the 17th of October, will be acted upon and the result reported to you by the recording secretary.

Allow me to add my personal thanks for the kind sympathy with us in our great misfortune, which the Institute has expressed through you, as well as for the offer of your publications to replace those lost.

Any of these publications which you can conveniently spare will be gratefully received. They may be sent to the care of Geo. C. Walker Esq., corner of Peck Court and Michigan Avenue, Chicago.

Very sincerely yours, Wm. Stimpson.

The following correspondence was also announced :—

From Albany Institute, Dec. 14; Bonn, Naturhistorische Verein, July 5; Bordeaux, Société Linnéene, July 12; Buffalo Historical Society, Dec. 8; Chicago Academy of Sciences, Dec. 4; Emden, Naturforschende Gesellschaft Sept. 22; Geological Survey of India, June 1; London Society of Antiquaries, Aug. 14; Luneburg, Naturwissenschaftliche Verein, Aug. 17; München, K. B., Akademie der Wissenschaften, Sept. 30; New York Historical Society, Dec. 4; New York Lyceum of Natural History, Dec. 4; Strasburg Library, Appeal for the Restoration

of, Nov.; Würzburg, Physicalisch-medicinische Gesellschaft, Aug. 11; H. M. Alden, New York, Dec, 6; Frank S. Sleeper, Galesburg, Mich., Dec. 7; E. M. Stone, Providence, R. I., Dec. 8.

The LIBRARIAN reported the following additions to the library :—

By Donation.

ALLEN, STEPHEN M. Standish Monument. Exercises at the Consecration at Duxbury, Aug. 17, 1871. 8vo pamph.

CHAPMAN, GEORGE R. Annual Report of the A. B. C. F. M., presented at the meeting in Salem, Oct. 3-6, 1871.

PREBLE GEO. H., of Charlestown, Mass. Notes of Early Ship-building in Massachusetts. 8vo pamph.

SCHAUFUSS L., of Dresden. Miscellaneous Catalogues, 12.

By Exchange.

ARCHIV FÜR ANTHROPOLOGIE IN BRAUNSCHWEIG. Heft. 1v, Band 1v.

BOTANISK TIDSSKRIFT IN KJÖBENHAVN TIDSSKRIFT. Vol. iv, Tredje Heft, 1870.

CROSSE ET FISCHER. Journal de Conchyliologie. Tome 1. Nos. 1-2-3. Paris, 1871.

ENTOMOLOGISCHE ZEITUNG IN STETTIN. Herausgegeben von dem entomologischen Vereine zu Stettin. Jahrg. 31. Nos. 1-2, 1870. 1 vol., 8vo. Stettin, 1870.

GEOLOGICAL SURVEY OF INDIA. Memoirs of the, Vols. I, II, III, IV, V, VI, and parts 1, 2, 3 of Vol. VII. Records of the, Vol. II, III, parts 1, 2, of Vol. IV. Cretaceous Cephalopoda and Cretaceous Castopoda of Southern India. 2 vols. 4to. 1868. Catalogue of the Organic Remains belonging to the Cephalopoda and Echinodermata. 8vo pamph. Cretaceous Fauna of Southern India, Vol. III, Nos. 1-8. 4to pamph. Calcutta, 1870. Fossil Flora of Rajmahal Series. 6 nos. On Vertebrate Panchet Rocks, Bengal.

IOWA STATE HISTORICAL SOCIETY. The Annals of Iowa. Oct., 1871. 8vo pamph.

KONGELIGE DANSKE VIDENSKABERNES SELSKAB IN KJÖBENHAVN. Oversigt, 1870, 1871. 2 pamphlets. 8vo.

LITERARY AND PHILOSOPHICAL SOCIETY OF LIVERPOOL. Proceedings, 1868-9, 1869-70. Vols. 23, 24. 2 vols. 8vo. Liverpool. 1869-70.

NATURFORSCHENDE GESELLSCHAFT IN EMDEN. Jahresbericht, 1870. 12mo pamph. 1871.

NATURHISTORISCHE VEREIN DER PREUSSISCHEN RHEINLANDE UND WESTPHALENS IN BONN. Verhandlungen. 27, Jahrg. Heft. 1, 2. 2 vols. 8vo. Bonn. 1870.

NATURWISSENSCHAFTLICHEN GESELLSCHAFT "ISIS" DRESDEN. Sitzungsberichte, Jan., Feb., März. 1871. 8vo pamph. Dresden. 1871.

REALE ACCADEMIA DELLE SCIENZE IN BOLOGNA. Rendiconto, Anno Accademico. 1869-70, 1870-71. 2 pamphlets, 12mo. Universalita dei mezzi di previdenza, defesa, e sabrezza per le Calamità degli Incendia. Opera Premiata in Concorso dalla Accademia delle Scienze dell' Instituto di Bologna. Scritter da Francesco del Giudice. Bologna, 1848. Royal 8vo. Della Instituzione dé Pompieri per grandi città e terre minori di qualunque stato; Libri Tre, né quali si tratta delle regole generali per fondare Compagnie di Soccoritori contro gl' incendi; si compendiano, esaminano e paragonano tra laro molti regolamenti oggi in vigore in Europa; e si propone una nuova forma di Statuto per quelli de essere dorunque

adatto. Opera Premiata in Concorso dalla Accademia delle Scienza dell' Instituto di Bologna e scritter dal Cavaliere Francesco del Giudice. Bologna, 1852. Royal 8vo.

SOCIETA REALE DI NAPOLI; ACCADEMIA DELLE SCIENZE FISICHE E MATEMATICHE. Atti dell' Accademia delle Scienze Fisiche e Matematiche. Vols. III, IV. Napoli, 1866-68-69. 4to pamph. Renediconto, Anno VI, VII, VIII, 1867-8-9. 4to pamph.

ST. GALLISCHE GESELLSCHAFT IN ST. GALLEN. Bericht. Vereins jahres, 1869-70. 1 vol. 8vo. St. Gallen, 1870.

VERMONT HISTORICAL SOCIETY. Vindication of Vol. I of the Collections from the "Attacks of the N. Y. Historical Magazine" by Hiland Hall. 8vo pamph. Montpelier, 1871.

ZOOLOGISCHE GESELLSCHAFT FRANKFURT A. M. Zoologische Garten. XII Jahrg. Nos. 1-6. Jan-June, 1871. 6 pamphlets, 8vo.

PUBLISHERS. American Literary Gazette. Gardener's Monthly. Gloucester Telegraph. Haverhill Gazette. Lawrence American. Little Giant. Lynn Reporter. Lynn Transcript. Medical and Surgical Reporter. Nation. Nature. Peabody Press. Shoe and Leather Journal. The Academy.

The following donations to cabinets were reported.

A. B. C. F. M. Papers relating to N. A. Indian affairs formerly belonging to Mr. John Pickering of Salem. Signatures of the members of the Board attending the meeting held in Salem, Oct., 1871.

BOLLES, E. C. A picture of Brooklyn Orphan Asylum.

CONSTANT, C., of Smyrna. No. I. Moule antique trouvé sur la route entre Smyrna et Boudja. No. II. Téte cassée statuette antique trouvée dans l' ile de Rhodes. No. III. Lampe ou porte-lumiére antique trouva dans l' ile de Rhodes. No. IV. Petit vase ou urne cineraira trouvi dans l' ile de Rhodes.

NICHOLS, W. F., Cypress from Smyrna. Myrobalon from India. Unleavened Bread of the Armenians from Smyrna. Oak for tanning from Smyrna. A piece of Mosaic work from Pompeii. A piece of Lava from Smyrna. Views of Interno Cappella Palatina Palermo, Chiostro Morreale, Messina dai Cappriccini.

RAYMOND, B. C., of Beverly. Pincers used by Major John Conant of Beverly, who flourished about one hundred years ago. He made the fisherman's heavy boots.

Mr. F. W. PUTNAM gave an account of the Mammoth Cave and its inhabitants, with special reference to the fishes of the cave and of other subterranean waters.* He called attention to the varied conditions under which fishes exist, and especially to the structure and position of the eye in different representatives of the class. He then compared the blind fishes of the Mammoth Cave with those of the Cuban Caves and with the blind catfishes

* Mr. Putnam's remarks will be given in detail in the *American Naturalist* for January, 1872, and will be illustrated by plates on which the various species of the family including the blindfishes of the Mammoth Cave will be represented.

belonging to different families, and described the species making up the family of Heteropygii, which contains the two species of blind fishes of the Mammoth Cave and two other species that have eyes. Giving a statement of the various theories relating to the non-development of eyes in the blind fishes of the cave, he asked why is it necessary to assume that because fishes are living in streams where there is little or no light, that it is the cause of the non-development of the eye and the development of other parts and organs? If this be the cause, how is it that the Chologaster from the well in Tennessee, or the "mud-fish" of the Mammoth Cave are found with eyes? Why should not the same cause make them blind if it made the Amblyopsis and Typhlichthys blind? Is not the fact, pointed out by Prof. Wyman, that the optic lobes are as well developed in Amblyopsis as in allied fishes with perfect eyes, and, I may add, as well developed as those of *Chologaster cornutus*, an argument in favor of the theory that the fishes were always blind and that they have not become so from the circumstances under which they exist? If the latter were the case and the fishes have become blind from the want of use of the eyes, why are not the optic lobes also atrophied, as is known to be the case when other animals lose their sight? I know that many will answer at once that Amblyopsis and Typhlichthys have gone on further in the development and retardation of the characters best adapting them to their subterranean life, and that Chologaster is a very interesting transitionary form between the open water Cyprinodontes and the subterranean blindfishes. But is not this assumption answered by the fact that Chologaster has every character necessary to place it in the same family with Amblyopsis and Typhlichthys, while it is as distinctly and widely removed from the Cyprinodontes as are the two blind genera mentioned?

After reviewing the characters of the allied forms, he concluded his remarks as follows :—

From this brief comparison of some of the prominent characters of the genera of the Heteropygii with the Cyprinodontes, their acknowledged nearest allies, we can only trace what could be regarded as a transition, or an acceleration, or a retardation, of development, in simply those very characters, of eyes and ventral fins, that are in themselves of the smallest importance in the structure (permanence of character considered) of a fish, and, as if to show that they were of no importance in this connection, we find in the same cave, blind fishes with ventrals and without; and in the same subterranean stream, a blindfish and another species of the family with well developed eyes.

If it is by acceleration and retardation of characters that the Heteropygii have been developed from the Cyprinodontes, we have indeed a most startling and sudden change of the nervous system. In all fishes the fifth pair of nerves send branches to the various parts of the head, but in the blindfishes these branches are developed in a most wonderful manner, while their subdivisions take new courses and are brought *through* the skin, and their free ends become protected by fleshy papillæ, so as to answer, by their delicate sense of touch, for the absence of sight. At the same time the principle of retardation must have been at work and checked the development of the optic nerve and the eye, while acceleration has caused other portions of the head to grow and cover over the retarded eye.

Now, if this was the mode by which blindness was brought about and tactile sense substituted, why is it that we still have *Chologaster Agassizii* in the same waters, living under the same conditions, but with no signs of any such change in its senses of sight and touch? It may be

said that the Chologaster did not change because it probably had a chance to swim in open waters and therefore the eyes were of use and did not become atrophied. We can only answer, that if the Chologaster had a chance for open water, so did the Typhlichthys and yet that is blind.

If the Heteropygii have been developed from Cyprinodontes, how can we account for the whole intestinal canal becoming so singularly modified, and what is there in the difference of food or of life that would bring about the change in the intestine, stomach and pyloric appendages, existing between Chologaster and Typhlichthys in the same waters? To assume, that under the same conditions, one fish will change in all these parts and another remain intact, by the blind action of uncontrolled natural laws, is, to me, an assumption at variation with facts as I understand them.

Looking at the case from the standpoint which the facts force me to take, it seems to me far more in accordance with the laws of nature, as I interpret them, to go back to the time when the region now occupied by the subterranean streams, was a salt and brackish water estuary, inhabited by marine forms, including the brackish water forms of the Cyprinodontes and their allies (but not descendants) the Heteropygii. The families and genera having the characters they now exhibit, but most likely more numerously represented than now, as many probably became exterminated as the salt waters of the basin gradually became brackish and more limited, as the bottom of this basin was gradually elevated, and finally, as the waters became confined to still narrower limits and changed from salt to brackish and from brackish to fresh, only such species would continue as could survive the change, and they were of the minnow type represented by the Hetero-

pygii, and perhaps some other genera of brackish water forms that have not yet been discovered.

In support of this hypothesis we have one species of the family, *Chologaster cornutus*, now living in the ditches of the rice fields of South Carolina, under very similar conditions to those under which others of the family may have lived in long preceding geological times; and to prove that the development of the family was not brought about by the subterranean conditions under which some of the species now live, we have the one with eyes living with the one without, and the South Carolina species to show that a subterranean life is not essential to the development of the singular characters which the family possess.

That a salt or brackish water fish would be most likely to be the kind that would continue to exist in the subterranean streams, is probable from the fact that in all limestone formations caves are quite common, and would in most instances be occupied first with salt water and then brackish, and finally with fresh water so thoroughly impregnated with lime as to render it probable that brackish water species might easily adapt themselves to the change, while a pure fresh water species might not relish the solution of lime any more than the solution of salt, and we know how few fishes there are that can live for even an hour on being changed from fresh to salt, or salt to fresh, water. We have also the case of the Cuban blindfishes belonging to genera with their nearest representative in the family a marine form, and with the whole family of cods and their allies, to which group they belong, essentially marine. Further than this the catfish from the subterranean stream in Pennsylvania belongs to a family having many marine and brackish water representatives.

Thus I think that we have as good reasons for the belief in the immutability and early origin of the family of Het-

eropygii, as we have for their mutability and late development, and to one of my, perhaps, too deeply rooted ideas, a far more satisfactory theory; for, with our present knowledge, it is but theory on either side.

The following synopsis gives a summary of the characters of the family, genera and species.

HETEROPYGII Tellkampf, Müller's Arch. f. Anat., p. 392, 1844; and New York Journal of Medicine, v, p. 84, 1845.

Hypsœidæ Storer, Synopsis N. A. Fish, p. 435, 1846.

Brain of ordinary development in all its parts, similar to that of Cyprinodontes and of about the same proportions. Cerebral lobes larger than the nearly round optic lobes. Cerebellum overlapping the posterior third of the optic lobes. Medulla oblongata broad, with well defined right and left sides. (On comparing the brains of the three genera the only difference noticed was that in Chologaster the cerebellum was not quite as large proportionally, but more elongated and not quite as wide as in the other genera, while the optic lobes of this genus with well developed eyes were no larger than in a Typhlichthys of the same size.)

Skeleton not studied. Günther gives the vertebræ as thirteen abdominal and nineteen or twenty caudal. The bones of the head are thin and mostly flattened as in the Cyprinodontes. Occiput slightly convex.

Body compressed posteriorly. Head and anterior portion of body depressed, giving the form of a broad, flat head, with a compressed tail.

Branchiostegal rays six in number and but slightly covered by opercular bones; opercular opening large.

Fins. Dorsal and anal nearly opposite and posterior to centre of body. All the fins except the ventrals well developed, with central rays longest and first rays simple. Pectorals close to the head, about in the middle of the sides. (Ventrals present in Amblyopsis, absent in Typhlichthys and Chologaster.)

Mouth opening upwards, with lower jaw slightly projecting. Margin of the upper jaw formed by the intermaxillaries. Maxillaries placed behind the intermaxillaries, with lower third broad and below the intermaxillaries. Several rows of fine teeth on the intermaxillaries and lower jaw. (Teeth on palatines in Amblyopsis and Typhlichthys, none on these bones in adults of Chologaster.)

Scales. None on the head. Body closely covered with small, partially imbedded cycloid scales, irregularly arranged.

Lateral line absent.

Nostrils double. Anterior tubular and standing out from the end of the snout.

Stomach well defined, cœcal.

Pyloric appendages present.

Intestine with two turns.

Anus situated under the throat and forward of the pectorals.

Ovary single. (Placed by the side of the stomach in Amblyopsis and Typhlichthys and behind it in Chologaster.)

Viviparous. (Amblyopsis.)

Testes paired. (Amblyopsis.)

Air bladder with pneumatic duct. (Amblyopsis.)

Liver with the left lobe very large and partially enclosing the stomach.

Amblyopsis DeKay, Fishes of New York, p. 187, 1842.

Eyes rudimentary and imbedded under the skin.

Head with numerous transverse and longitudinal rows of sensitive papillæ provided with nerve branches, many of the nerve branches terminating as free filaments outside the papillæ. Small granulations on the spaces between the papillary ridges. Canals under the skin.

Teeth minute, curved, and arranged in rows on the intermaxillary, inferior maxillary and palatine bones.

Body with a prominent papilla just over the opercular opening, at the base of a small papillary ridge similar to those on the head. Papillary ridges on sides of body of same character as those on the head, and arranged at nearly equal distances from opercular opening to base of caudal fin.

Pyloric appendages, one on each side.

Ovary situated on the right side of the stomach.

Fins. Ventrals small and placed near the anal fin. Dorsal, 9. Anal, 9. Pectoral, 11. Ventral, 4. Caudal, 24.

Amblyopsis spelæus DeKay. Large Blindfish.

Craige, Procd. Acad. Nat. Sci. Philad., i, p. 175, 1842. DeKay, Fishes N. Y., p. 187, 1842. Wyman, Amer. Jour. Sci., xlv, p. 94, 1843; Ann. Mag. Nat. Hist., xii, p. 298., 1843. Thompson, Ann. Mag. Nat. Hist., xiii, p. 111, 1844. Tellkampf, Müller's Arch. f. Anat., p. 392, 1844; N. Y. Jour. Medicine, v, p. 84, with plate, giving three figs. of the fish; position of internal organs; brain; stomach; air bladder; scale (profile view gives the fish *without* ventral fins, but ventral view shows them), 1845. Storer, Synopsis N. A. Fish, p. 435, 1846. Owen, Lect. Comp. Anat. Fishes, pp.

175, 202 (fig. of brain), 1846. WYMAN, Procd. Boston Soc. Nat. Hist., iii, p. 349, 1850. "DALTON, N. Y. Medical Times. ii, p. 354, 18—." AGASSIZ, Amer. Jour. Sci. xi. p.128, 1851. WYMAN, Procd. Boston Soc. Nat. Hist., iv, p. 395 (1853), 1854; v, p. 18, 1854; Amer. Jour. Sci., xvii, p. 259, 1854 (with figs. of brain, eye, and otolite). GIRARD, Proc. Nat. Sci. Philad., p. 63, 1859. POEY, Mem. de Cuba, ii, p. 104, Pls. 9, 11 (outlines of fish and of brain), 1858. WOOD, Ill. Nat. Hist., iii, p. 314, figure, 1862. TENNEY, Nat. Hist., p. 344, figure, 1865. GÜNTHER. Cat. Fish Brit. Museum, vii, p. 2, 1868. COPE, Ann. Mag. Nat. Hist., viii, p. 368, 1871. PUTNAM, Amer. Nat., vi, p. 6 et seq., with figs., Jan., 1872. WYMAN, Mss. notes and drawings in Putnam, Amer. Nat., vi, p. 16 et seq., 1872. PUTNAM, Amer. Nat., vi. p. 116. Feb., 1872 (additional note on the young).

PLATE 1 (American Naturalist, Vol. vi, Jan., 1872). FIG. 1. Brain, nerves and organ of hearing of *Amblyopsis spelæus;* enlarged; *a*, olfactory lobes and nerves; *b*, cerebral lobes; *c*, optic lobes; *d*, cerebellum; *e*, organ of hearing, showing the semicircular canals, with the otolite represented in place by the dotted lines; *f*, medulla oblongata; *g*, optic nerves and eye specks. FIG. 2. Otolite, enlarged. FIG. 3. Eye, magnified (natural size one-sixteenth of an inch in length); *a*, optic nerve; *b*, sclerotic membrane; *c*, layer of colorless cells; *d*, layer of pigment cells (iris?); *e*, lens. FIG. 4. Lens, enlarged and showing the cells. FIG. 5. Eye, enlarged, showing the muscular bands, *a*, *a*, *a*, *a*; *b*, the lens pressed out of place; *c*, the optic nerve. FIG. 6. Top of head, showing canals under the skin, natural size. The two black dots and lines indicate the eyes and optic nerves in position. FIG. 7. Top of head, showing the arrangement of the ridges of papillæ, nat. size. FIG. 8. One of the ridges of papillæ from the head, magnified. FIG. 9. Three of the papillæ from the ridge, still more magnified, showing the cup-shaped summit and projecting filament. Fig. 10. A portion of the ridge magnified, and treated with acid, to show the arrangement of the nervous plexus supplying the papillæ with nervous filaments from a branch (*a*) of the fifth pair. FIG. 11. Epithelial cells from the head. FIG. 12. Epithelial cells from the body.

PLATE 2. FIG. 1. Natural size; 1*a*, stomach and pyloric appendages, twice nat. size; 1*b*, scale, magnified (nat. size represented by the small outline on the left over the figure); 1c, abdominal cavity, showing position of stomach and single ovary, nat. size.

Head more than half as wide as it is long. Length of head, from tip of jaw to end of operculum, contained nearly twice in length of body from operculum to base of caudal fin.

Dorsal and anal fins of equal size, rounded, anal commences under third ray of dorsal.

Pectorals pointed, reaching to commencement of dorsal.

Ventrals pointed, nearly reaching to commencement of anal.

Caudal broad, long and pointed, membrane, enclosing simple rays above and below, continuing slightly on the tail.

Scales small, longer than broad, with quadrangular centre and from 8 to 12 concentric lines, which are broken and reduced in number anteriorly and crossed by numerous radiating furrows posteriorly.*

Colorless, or nearly so, with transparent fins.

* The scales described were in every instance taken from the 2d or 3d row under the dorsal fin.

Measurements. Largest specimen, 4·5 inches total length. Smallest specimen, 1·9 total length.

Geographical distribution. Subterranean streams in Kentucky and Indiana.

Specimens examined:—

PROF. WYMAN'S COLLECTION.

7 specimens. Half grown and adults. Mammoth Cave.

MUSEUM OF COMPARATIVE ZOOLOGY.

7 specimens. No. 778. Half grown and ♂ ♀ adults. Mammoth Cave.

1 specimen. No.—. Two-thirds grown. Cave near Lost River, Orange Co., Ind.

BOSTON SOCIETY OF NATURAL HISTORY.

2 specimens. No. 840. Half grown. Mammoth Cave.

PEABODY ACADEMY OF SCIENCE.

1 specimen. No. 520. Adult ♀. Mammoth Cave. Presented to Essex Institute in 1851 by N. Silsbee.

Other specimens. Dr. Günther mentions six specimens and a skeleton in the British Museum. Mr. Thompson, an adult and newly born young in the collection of the Natural History Society of Belfast. Dr. Steindachner has recently sent an adult and eight young to the Vienna Museum. The first specimen of which we have any record was presented to the Academy of Natural Sciences of Philadelphia; the second is the one described by DeKay and then in the Lyceum of Natural History of New York. Prof. Cope obtained three specimens from the waters of Wyandotte Cave in Indiana. Dr. Tellkampf had several specimens from the Mammoth Cave, and it is probable that specimens exist in nearly all the principal museums and in many private collections, as about all that have been caught in the Mammoth Cave for years have been sold by the guides to visitors.

Habits. But little is known of the habits of the large blindfish. Dr. Tellkampf states that they are solitary; on the slightest motion of the water they dart off a short distance, and that they are mostly found near stones or rocks on the bottom, and seldom come to the surface of the water. Prof. Cope states that if they are not alarmed they come to the surface to feed, swim in full sight, and can then be easily captured if perfect silence is preserved. He also thinks that they are principally surface feeders.

In the stomachs of several that I have opened the only remains found were those of Crayfish. In one specimen, opened by Dr. Wyman, a small fish with well developed eyes was found in the stomach. (See Amer. Nat., vi, p. 13, Pl. 1, fig. 13.)

The eggs are well developed in September, and the young are born about the middle to last of October. The young when born are half an inch or less in length, and are *without* external eyes. (See Amer. Nat., Feb., 1872. The young there mentioned may possibly be those of Typhlichthys.)

Typhlichthys GIRARD, Procd. Acad. Nat. Sci. Philad., p. 63, 1859.

Eyes rudimentary and imbedded under the skin.

Head. The same arrangement of rows of sensitive papillæ as in Amblyopsis, and the spaces between the papillæ with granulations as in that genus. (The subcutaneous canals probably exist, but have not yet been made out.)

Teeth, as in Amblyopsis, on the maxillaries and palatines.

Body with papilla over opercular opening, and with the papillary ridges on the sides as in Amblyopsis.

Pyloric appendages one on each side as in Amblyopsis, but of slightly different proportion and shape. (Stomach not so pointed behind as in Amblyopsis.)

Ovary situated on right side of stomach, as in Amblyopsis. (Eggs fewer in number and proportionately larger than in Amblyopsis.)

Fins. Ventrals *absent.* Dorsal, 7 or 8; Anal, 7 or 8; Pectoral, 12; Caudal 24. (This formula is given after counting several specimens. Girard gives, D. 7; A. 8; P. 11; C. 23.)

It will be noticed that the only characters separating this genus from Amblyopsis are the *absence of ventral fins*, the shape of the stomach and pyloric appendages, and larger eggs in less number.

Typhlichthys subterraneus GIRARD. SMALL BLINDFISH.

GIRARD, Procd. Acad. Nat. Sci. Philad., p. 63, 1859. GÜNTHER, Cat. Fish Brit. Museum, vii, p. 2, 1868 (as a syn. of Amblyopsis). PUTNAM, Amer. Nat., vi, p. 20 et seq., with figs., Jan., 1872.

PLATE 2 (Amer. Nat., Vol. vi., Jan., 1872). FIG. 3, slightly more than natural size; 3*a*, stomach and pyloric appendages, twice nat. size; 3*b*, scale, magnified (nat. size represented by small outline over the figure).

Proportions and general appearance, want of color, arrangement of papillary ridges, position and shape of fins as in Amblyopsis spelæus, with the exception that, owing to the jaws being more obtusely rounded, the head is slightly blunter and broader forward.

Membrane of caudal quite prominent and extending forwards to posterior base of dorsal and anal fins.

Scales broader than long. Large quadrangular centre with from 6 to 8 concentric lines reduced in number and broken up on anterior margin. Posterior portion with numerous radiating furrows.

Measurements. Largest specimen, 1·85 inches in total length. Smallest specimen, 1·45 inches in total length.

Geographical distribution. Subterranean streams in Kentucky, Tennessee and Alabama.

Specimens examined: —

MUSEUM OF COMPARATIVE ZOOLOGY.

7 specimens. No. 780. ♂ ♀. Adults. Mammoth Cave. Collected and presented by Alpheus Hyatt, Sept., 1859.
1 specimen. No. 781. Moulton, Alabama. Presented by Thomas Peters.
1 specimen. No. 782. Lebanon, Tennessee. Presented by J. M. Safford.

Other specimens. Dr. Girard described the species from a specimen in the Smithsonian Institution, taken from a well near Bowling Green, Ky. Dr. Günther mentions a specimen, in the British Museum, from the Mammoth Cave.

Habits. Nothing is known concerning the habits of this fish. It is evidently much rarer at the Mammoth Cave than the large species, to judge from the small number in collections. The fact that Mr. Hyatt obtained seven specimens when he was at the cave in September and did not get any of the other species, may indicate some peculiar location in the waters of the cave where it is more abundant than in other places. The eggs were fully developed in these specimens, but no embryos could be detected. The fish is probably viviparous, and very likely gives birth to its young in October.

Chologaster AGASSIZ, Amer. Jour. Sci., xvi, p. 135, 1853.

Eyes in normal position and well developed.

Head with small granulations on the surface of the skin. (No papillary ridges.)

Teeth minute, curved and arranged in rows on the intermaxillary and inferior maxillary bones. None on the palatines in the adults (Of the four specimens examined, the two larger (*C. cornutus*) are without palatine teeth, while the single specimen of *C. Agassizii*, which is evidently a young fish, has a few minute teeth on the palatine bones. In the smallest specimen of *C. cornutus* the mouth is abnormal, the intermaxillaries being reduced to a small central portion and there are consequently no teeth in the upper jaw, but the minute teeth on the palatines are present.*)

---

*I believe this is one of those interesting cases where one set of organs, or one portion of the animal structure, takes the place of another which from accident is wanting, and that in all probability these palatine teeth, that under normal conditions would be cast off as the fish attained maturity, would have continued to exist in this specimen and answer all the purposes of the intermaxillary teeth. But that in this accidental continuance of these palatine teeth, from the mere mechanical use forced upon them, we have the first stages of the development of a distinct genus, to be characterized by permanent teeth on the palatines, and reduced upper jaw bones, as many of the developmental school would argue, I do not think will bear the test of facts observed.

A not uncommon malformation of fishes consists in the entire or partial absence of the maxillary or intermaxillary bones. I have specially noticed this among our

(*Body* without opercular papilla and papillary ridges on the sides.)

Pyloric appendages two on each side. Stomach rounded and turned slightly on the side.

Ovary situated principally behind the stomach.

Fins. Ventrals *absent.* Dorsal, 8 or 9. Anal, 8 or 9. Pectoral, 12. Caudal, 28.

This genus principally differs from Amblyopsis and Typhlichthys by the presence of eyes, the absence of papillary ridges on the head and body, by having two pyloric appendages on each side instead of one, and by the posterior position of the ovary. It agrees with Typhlichthys in the absence of the ventrals, and the young further agree by the presence of palatine teeth.

Chologaster cornutus Agassiz.

Agassiz, Amer. Jour. Sci., xvi, p. 135, 1853. Girard, Procd. Acad. Nat. Sci. Philad., p. 63, 1859. Günther, Cat. Fish. Brit. Museum, vii, p. 2, 1868. Putnam, Amer. Nat., vi, p. 21 et seq., with figs. Jan., 1872.

Plate 2 (Amer. Nat., Vol. vi, Jan., 1872). Fig. 2. Natural size. 2*a*, stomach and pyloric appendages, twice nat. size. 2*b*, scale magnified (nat. size represented by small outline over the left of the fig). 2*c*, abdominal cavity showing stomach and single ovary behind the stomach, twice nat. size.

Head more than half as wide as it is long. Length of head, from tip of under jaw to end of operculum contained twice in length of body from operculum, to caudal fin. Width between the eyes equal to distance from eye to tip of under jaw.

Eyes of moderate size, situated just back and over the end of the maxillaries.

Dorsal and anal fins of nearly equal size, slightly rounded. Anal with slightly longer rays and commences under fourth ray of dorsal.

Pectoral fins pointed, reaching to line of commencement of dorsal.

Caudal fin pointed, about equal in length to the head. Membrane above and below extending but slightly on the tail.

Scales very small and deeply imbedded in the skin. Circular with small smooth space forward of the centre. From 15 to 20 concentric rings, cut by a few short radiating furrows on anterior, and longer and more numerous ones on posterior margin.

Intestine is a little longer than in an Amblyopsis of the same size.

---

common fresh water trout (Salmo) and marine conner or sea perch (Ctenolabrus) but there have never been recorded allied genera with these characters, while the malformed specimens are hardly numerous enough to give support to the theory that such malformations are hereditary, and it is probable that each case was caused by the non-development of the parts from special cause during embryonic life, or by accident to the individual.

The two pyloric appendages on the left side are close together and broader than the two on the right side, which are wider apart, longer and more slender than the others.

Color. Yellowish brown, much darker above, lighter on sides, and light yellow on under part and sides of head, belly and under part of tail. Three longitudinal very dark brown lines on each side: the upper commencing near the middle of top of head and following along the back to base of caudal fin; the middle one commencing at the nostril and passing through the eye to upper portion of operculum, thence about in the centre of side to about the centre of base of caudal fin; the lower commences under the pectoral fin and follows the ventral curve of the body to the base of caudal fin. All three lines are darkest and broadest forward, and terminate as a series of nearly confluent dots on the tail. Central rays of the caudal dark brown, outer rays uncolored. Dorsal, anal and pectorals not colored.

Measurements. The three specimens are respectively 1·5, 2, and 2·3 inches in total length.

Geographical distribution. South Carolina.

Specimens examined:—

MUSEUM OF COMPARATIVE ZOOLOGY.

3 specimens. No. 776. Rice Ditches at Waccamaw, S. C. Presented by P. C. J. Weston, 1853. (Orig. of Agassiz.)

Habits. Nothing is known concerning the habits of this species, the only specimens observed being the three mentioned. From the fact of its having a single ovary containing a small number (about 60) of large eggs it is probable that it is viviparous.

Chologaster Agassizii PUTNAM.

PUTNAM, Amer. Nat., vi, p, 22 et seq., with figs. Jan., 1872.

PLATE 1 (Amer. Nat., Vol. vi, Jan., 1872). FIG. 4. Natural size; 4*a*, stomach and pyloric appendages, twice nat. size; 4*b*, scale magnified (nat. size shown by minute dot over left of the figure).

Head more than half as wide as it is long. Its length is contained three times in the length of the body from the operculum to the base of caudal fin.

Eyes proportionately large and placed over ends of maxillaries.

Dorsal and anal fins broken, but probably of about equal size. Anal fin commences about under fourth ray of dorsal.

Pectoral fins pointed and reaching about half way to the dorsal.

Caudal fin pointed, not quite as long as the head.

Scales very minute, longer than wide, with 4 or 5 concentric

lines round a granulated centre. A few radiating furrows cut the concentric lines on the posterior margin.

Pyloric appendages and stomach about the same as in *C. cornutus*.

Color. Uniform light brown, without markings except that the base of the caudal fin is rather darker than rest of fish. Fins uncolored.

Measurements. Total length, 1·4 inches.

Geographical distribution. Subterranean streams in Tennessee.

Specimen examined:—

MUSEUM OF COMPARATIVE ZOOLOGY.

1 specimen. No. 777. From a well in Lebanon, Tenn. Presented by J. M. Safford. Jan., 1854.

This species principally differs from *C. cornutus* by having a longer body and smaller head, by having the eyes proportionately larger, and by its coloration. Nothing is known of its habits except the fact of its subterranean life. The scales of the single specimen known indicate a young fish, and it is probably not over half grown.

The four species given in this synopsis are all of the family as yet known, but that others will be discovered and the range of the present known species extended is very probable. The ditches and small streams of the lowlands of our southern coast will undoubtedly be found to be the home of numerous individuals, and perhaps of new species and genera, while the subterranean streams of the central portion of our country most likely contain other species.